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E03B 11/02

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E1T T7C2

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None

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(54) Abstract Title
Storage tank and filtration unit for a grey water processing system

(57) A storage tank (fig 3) for a grey water processing system wherein the storage tank has an inflow (17) for water from the mains water system, the inflow being regulated by a regulating valve with associated water level dependent switching means, the inflow opening into a tube (18) that encompasses the inflow and valve (21) and directs the mains water therefrom downwardly through the tube, the tube opening into the tank toward the bottom of the tank and being provided with an air vent (27) to prevent siphoning back up the tube.

A filtration unit (fig 2) for a grey water processing system wherein the filtration unit comprises a tank with a grey water inflow at the bottom of the tank, a filter (5) positioned thereabove with a pumping means (6) to pump it toward a separate storage tank whereby particulate matter filtered from the grey water by the filter is partitioned into the lower part of the filtration unit tank to gravitate to the floor of the tank away from the filter and pump.

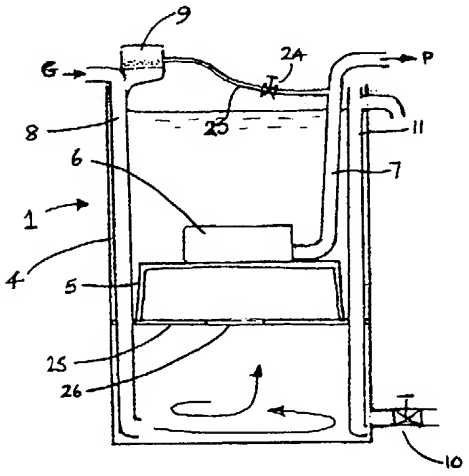

FIGURE 2

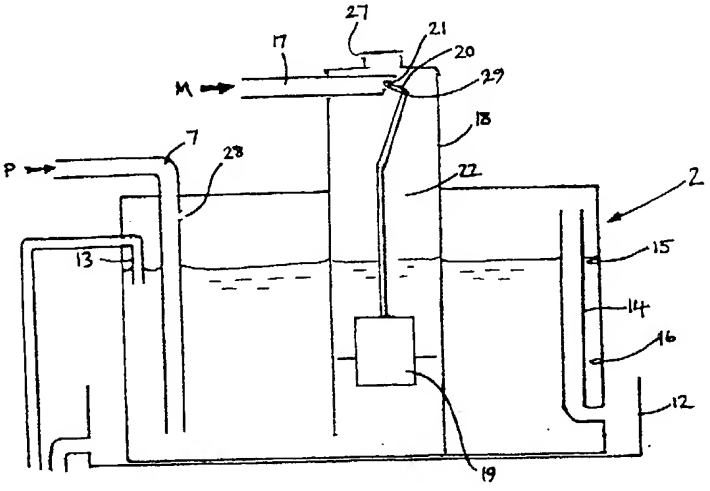

FIGURE 3

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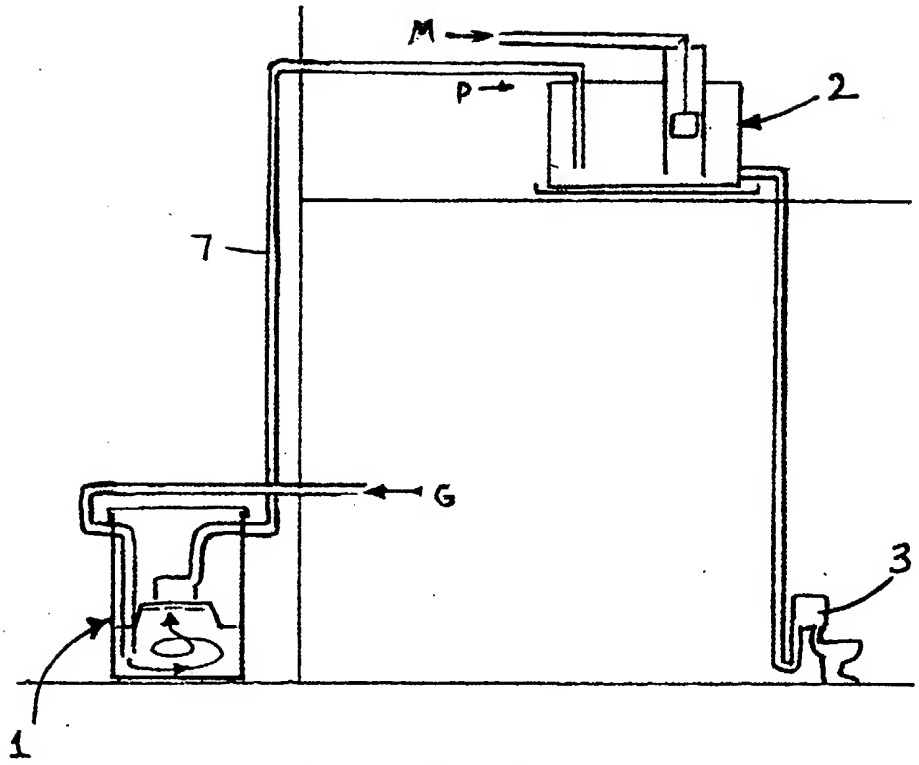

FIGURE 1

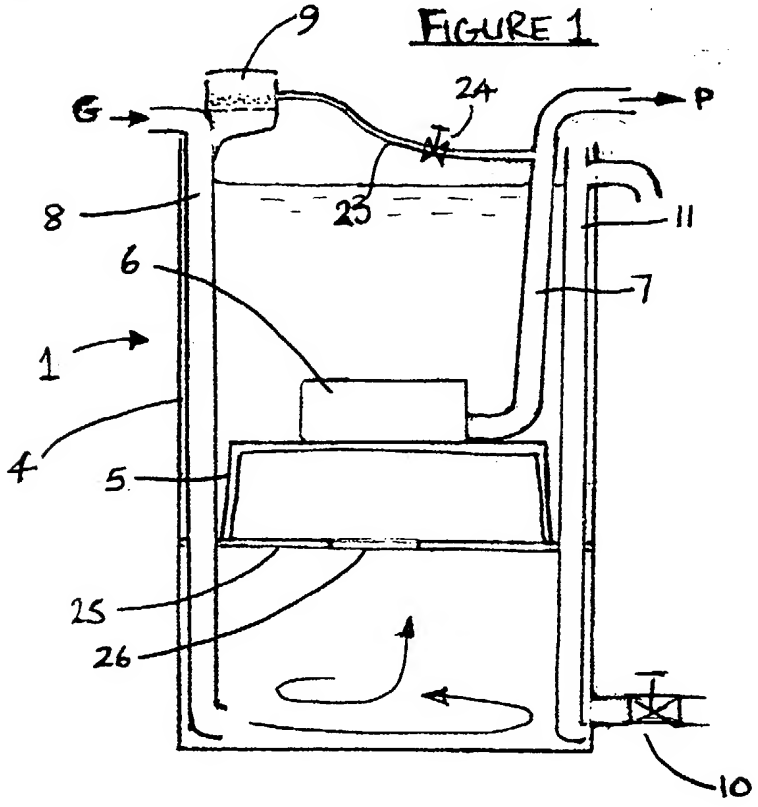

FIGURE 2

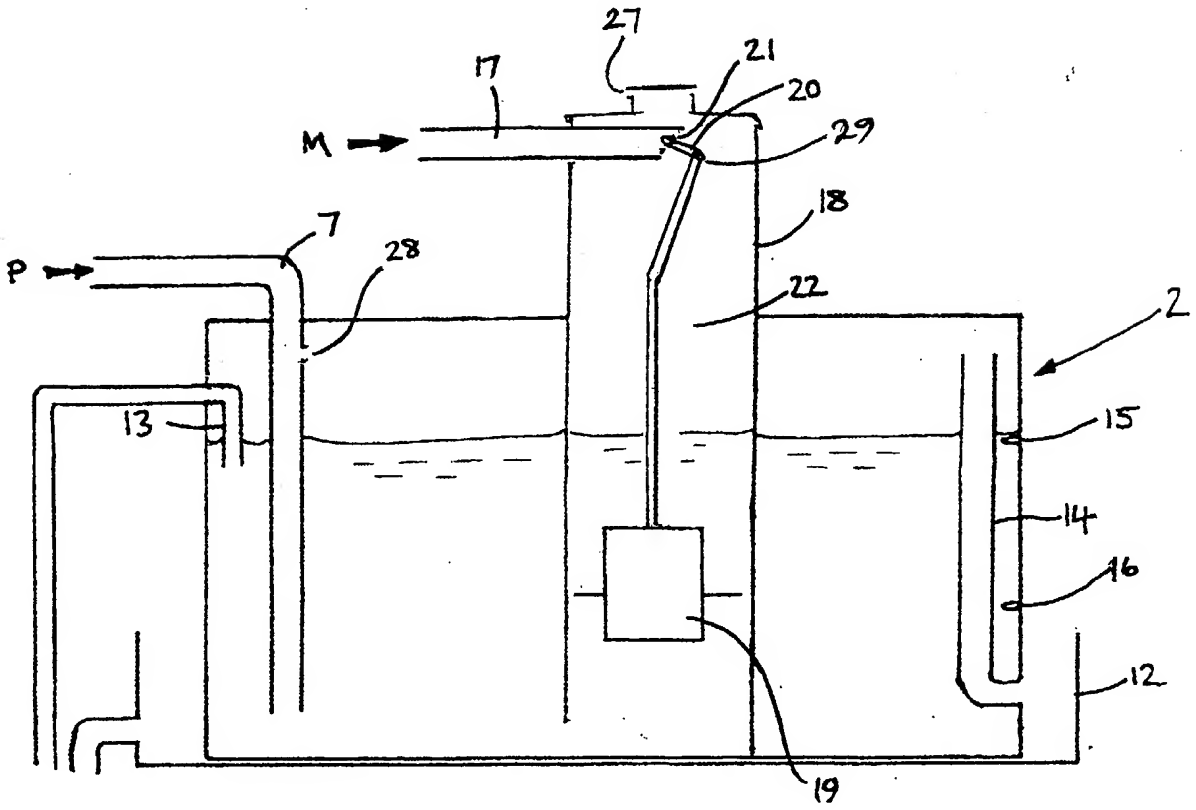

FIGURE 3

GREY WATER RECYCLING SYSTEM

Field of the Invention

The present invention concerns improvements in and relating to grey water recycling systems. However, although the system is described as being for grey water, the system may also be used to process rainwater in addition or alternative to grey water.

Background to the Invention

The value of conserving water resources is widely appreciated nowadays even in those countries blessed with high levels of annual rainfall such as the United Kingdom. Amongst the many measures taken to conserve water supplies, the re-use of water from baths, washing machines and the like is proving increasingly popular. Such water is generally termed as grey water. Although it carries contaminants, these can generally be removed by simple economical ultra filtration processes and re-used for similar tasks or tasks where the purity of the water is not of any great importance. Commonly, for example, the water from a washing machine, dish washer or bath may be processed to remove dirt, fibres and grease and fed to a cold water storage tank to then be delivered to a water closet cistern or the like.

By way of example of prior art, recently granted US patent US 5,868,937 discloses a grey water recycling system having these general attributes and which makes use of hollow fibre membranes for ultra filtration so that the same washing water can be re-cycled endlessly in a closed loop.

From in-depth experience of developing grey water processing systems, the applicant has found that there are a number of operational problems and limitations associated with the prior art systems. In particular, existing designs of system which

have a storage tank for the processed grey water make inadequate provision for supplementing the stored processed grey water if supplies should dwindle and also have inadequate provision for counter measures against condensation and risk of overflow. At the filtration end of the system, existing grey water processing systems may fail to achieve optimal efficiency in the filtration process.

It is a general objective of the present invention to address some or all of these drawbacks of the prior art.

Summary of the Invention

According to a first aspect of the present invention there is provided a grey water processing system which comprises a filtration unit to filter out particulate contaminants and a storage tank to store the grey water processed by the filtration unit, wherein the storage tank has an inflow for water from the mains water system, the inflow being regulated by a regulating valve with associated water level dependent switching means , the inflow opening into a tube that encompasses the inflow and valve and directs the mains water therefrom downwardly through the tube, the tube opening into the tank toward the bottom of the tank and being provided with an air vent to prevent siphoning back up the tube.

By housing the mains water inflow within such a tubular duct, a number of technical maintenance problems are resolved simultaneously. Firstly, the mains water inflow is kept at a suitable distance above the level of the grey water in the tank, being suitably substantially greater than 25 mm above the tank top. The tank may nevertheless remain fully covered to minimise evaporation or condensation from the tank.

Preferably the regulating valve is a ball cock valve. This avoids the risk of failure that applies to an electromechanical regulating valve upon loss of electricity,

providing a fail safe for the whole system in event of electric power failure so that appliances served by the system may continue to be used.

Where the regulating valve is a ball cock valve, because it is a substantial distance above the water in the tank the linkage between the ball cock valve and its float will be relatively lengthy, but there will be relatively low operating stresses and strains applied by the linkage to the valve and particularly the valve seat by virtue of the configuration of the linkage to operate within the confines of the duct.

The ducting of the mains water via the tubular duct also reduces foaming in the tank which in turn improves the flows through the tank and reduces need for maintenance.

The ability to fully encase the system not only helps minimise evaporative losses and external condensation but further enables the tank to be fully lagged to prevent condensation and risk of freezing. This is of particular importance when warm bath or washing water is processed and pumped into the tank, which is at a lower temperature.

According to a second aspect of the present invention there is provided a grey water processing system which comprises a filtration unit to filter out particulate matter and a storage tank to store the grey water processed by the filtration unit, wherein the filtration unit comprises a tank with a grey water inflow at the bottom of the tank, a filter positioned thereabove with a pumping means to pump water that passes through the filter toward the storage tank whereby particulate matter filtered from the grey water by the filter is partitioned into the lower part of the tank to gravitate to the floor of the tank away from the filter and pump.

Particularly preferably the inflow for the grey water has coupled thereto a chamber with air vents to aspirate air. Suitably this chamber is adapted to

accommodate processing chemicals whereby the chemicals may be drawn into the in flowing grey water.

Particularly preferably the filtration unit tank is a substantially cylindrical tank and the inflow of grey water opens into the base of the tank substantially tangentially to the cylindrical inner wall of the tank to cause the in flowing grey water to flow around the tank in a swirling motion. This causes suspended solids to separate and migrate to the edge of the tank in advance of the grey water passing through the filter.

Preferably the storage tank is provided with switch means responsive to the level of water in the tank to switch off the pump means should the level of water in the storage tank rise above a predetermined maximum level.

Preferably the storage tank further has a switch means responsive to the level of water in the tank to switch on the pump means should the water level in the storage tank fall below a predetermined lower or minimum level.

In each case, the switch means suitably comprises a float switch.

Brief Description of the drawings

A preferred embodiment of the present invention will now be more particularly described by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a schematic overview of the grey water processing system;

Figure 2 is a schematic sectional diagram of the filtration unit of the processing system;

and

Figure 3 is a schematic sectional diagram of the processed grey water storage tank of the processing system.

Description of the Preferred Embodiment

Referring firstly to Figure 1, this shows the overall grey water processing system as comprising a filtration unit 1 which would normally be situated at ground level outside of a building and which receives an inflow of grey water G from such conventional sources as a washing machine, bath or shower. The processed grey water P from the filtration unit 1 is pumped by the filtration unit 1 up to a storage tank 2 that would normally be located in a loft or upper storey of a building for subsequent gravity fed supply of the processed grey water to appliances such as a WC cistern 3.

Since processed grey water (or rain water) may not always be available, for full operational efficiency the grey water processing system needs to be integrated with the mains water system insofar as it may be supplemented by mains water when required. To this end, an inflow 17 for mains water M is provided in the storage tank 2.

Turning to Figure 2, this illustrates the general construction of the filtration unit 1. This comprises a cylindrical tank 4 that, for optimal cost economy, may comprise a large capacity plastics bin. This is suitably covered over, in use, with a vented lid.

Partway down the interior of the bin 4 is mounted the filtration device 5 and associated pump 6. As a further intermediate technology solution, the filtration device can be simply and cheaply constructed from a pair of plastics garden sieves that are nested together and sandwiching between them a washable/reusable filter pad. The nested sieves are suitably clipped together so as to firmly engage each other and hold the filter pad firmly in place and sealed against the support plate to prevent leakage.

The filter device 5 is supported in place part way down the tank 4 by a circular platform shelf 25 having a large central aperture 26. Alternatively the filter device 5 may be supported by a narrower circumferential shelf around the tank 4, by flanges or posts within the tank 4 or simply by virtue of the narrowing diameter of the tank 4 towards the floor of the tank. Where a cylindrical plastics waste bin is used it is quite common for these to have a slightly tapered profile and where the filtration device is of sufficient outside diameter it may lodge within the narrowing inside diameter of the bin at the requisite height therein and sealed against the bin with an edge sealing strip.

The use of a circular platform shelf 25 or circumferential shelf or the like with a central aperture 26 presents an initial barrier to solids in the grey water that are already generally partitioned away from the centre of the flow by a centrifugal effect. Furthermore it slows the grey water as it enters the filter chamber defined between the interior of the filter device 5 and shelf 25.

The pump 6 is securely fastened to the upper surface of the filtration device 5 and when switched on will draw filtered water that passes up through the filtration device 5 and pump it through delivery pipework 7 to the processed grey water storage tank 2. For most purposes the power demands of the pump 6 may be fairly modest and pumps with a minimum 6 meter head are suitable for most two storey buildings.

To counter torque reaction of the pump 6 a detent means is suitably provided at the base of the tank projecting to detain a support leg, fin or other prominent feature of the pump and/or filter device 5, stopping the pump/filter device 5 from turning within the tank 2

The grey water G from the various suitable sources around a building is piped by grey water inflow pipework 8 into the tank 4 of the filtration unit 1 at a level close to the bottom of the tank 4.

At the upper end of the inflow pipe 8 close to where the inflow pipe 8 enters the filtration unit tank 1 an aspiration chamber 9 is coupled into the inflow pipe 8. This aspiration chamber has a vent for air at its upper end and is adapted to hold treatment chemicals, including, for example, detergent and bactericides to gradually release the chemicals into the grey water G flowing through the inflow pipe 8 under negative pressure caused by the flowing water. This may be feed-assisted, for increased dosage during the pumping cycle by small amounts of processed grey water fed back from the outflow/delivery pipe 7 by a small conduit 23. Accordingly, the grey water in the filter unit tank 4 is lightly dosed automatically by aspiration to initially treat it as it enters the filter unit tank 4 and may be more heavily dosed during pumping of the processed grey water to ensure that the whole system is adequately dosed. This whole approach is in complete contrast to the chemical dosing in prior art systems, wherein chemicals are normally added in the loft storage tank 2 but not in the outside filter unit tank 4.

The lower end of the inflow pipe 8 is angled to direct the grey water G around the circular inner wall of the tank 4 to swirl.

During operation of the filtration unit 1 the grey water passes up through the shelf 25 aperture 26 and filter device primarily under force of gravity and the water will be filtered through the filter device 5 leaving the particulates – dirt and clothing fibres, for example, to fall back toward the floor of the lower compartment of the tank 4.

Over periods of time a layer of sediment may form within the tank 4 and this may easily be purged by opening of a clearance discharge valve 10, suitably a large

bore (eg 1/½ inch) slide gate valve, near the base of the tank 4. This also acts to partially discharge particulates from the filter pad. If necessary, additional water may be flowed into the tank 4 to back flush the filter. Under normal levels of usage, the tank need not be purged more than once a month or so and, needless to say, the water "cost" in purging the tank 4 is far less than the water savings through use of the grey water processing system.

In case the tank 4 of the filtration unit 1 should begin to overfill if, for example, the static head increases as a result of filter blockage, an overflow pipe 11 is provided that bypasses the filter 5 and leads to drains. An air vent opening is provided at the top of the overflow pipe 11 to assist the overflow.

Any problems that might otherwise arise from excessively rapid inflow from the grey water delivery pipework 8 is mitigated by the aspiration of air by the aspiration chamber 9 and this may be further assisted by provision of conduit 23 between the processed grey water pipework 7 and the aspiration chamber 9 to transfer some processed water to the chamber 9. This may increase the pressure in the chamber 9 and hence provide resistance to slow down the inflow through the pipework 8. It suitably also has the earlier mentioned role of assisting dosing of the grey water with chemicals. This conduit 23 may further have a control valve 24 to adjust flow therethrough.

Turning to Figure 3, the storage tank 2 for the processed grey water P is substantially enclosed, having a lid to minimise evaporation from the tank and suitably being thermally lagged and having a first overflow 13 that drains into the building's normal water drainage system. The tank 2 sits in an overflow tray 12 to capture any water overflowing from the tank 2 via a second gross overflow 14. The overflow tray 12, in turn, drains into the buildings normal water drainage system.

The processed grey water delivery pipe 7 feeds the processed grey water P into the storage tank 2 at a point close to the bottom of the tank 2. A small vent hole 28 is provided in the grey water delivery pipe to prevent back siphoning and to reduce any surge of inflowing processed grey water and allow drainage of processed grey water back to the filter tank 4 to prevent there being standing water in the delivery pipe 7 that might freeze in winter.

The level of water in the tank 2 is regulated not simply by the provision of the respective overflows 13, 14 but also primarily by an electromechanical control system which comprises a pair of float switches 15, 16 and associated power control box (not shown) to activate or deactivate the pump 6 at the filtration unit 1.

An upper float switch 15 senses if the water level in the tank 2 should rise above a suitable maximum level and will, via the control box, trigger switching off of the pump 6.

A lower float switch 16 is positioned within the tank 2 at a height corresponding to a lower or minimum desired level of water within the tank 2 and will, via the control box, reactivate the pump 6 to continue supply of grey water from the tank 4 of the filtration unit 1.

The supply of processed water from the storage tank 2 to the appliances such as water closet cistern 3 is, as for most cold water supply systems, permanently open from the tank 2 through to the appliance so that water is always available on demand.

The basic control system operates relatively efficiently but fails to allow for the fact that the availability of a grey water (or rainwater) resource may not match the demand. To ensure that supply meets demand generally, the grey water system would need to be run in tandem to normal supply from the mains water system. This, however, leads to excessive duplication of pipework.

Better still, mains water M may be supplied to the stored processed grey water in the storage tank to supplement the water levels in the tank 2 should they fall too low and there not be sufficient grey water resource to replace them. Herein lies a difficulty, however, since mains water must not be allowed to become contaminated by grey water. The system of the present invention overcomes this problem.

The mains water inflow pipe 17 illustrated in the Figure 3 embodiment is located outside of the main body of the tank 2 but within the top part of a tubular duct 18 of broad diameter that extends through the roof of the tank 2 to at or near the floor of the tank 2 and having clearance at its bottom to allow fluid communication between the processed grey water in the tank 2 and the interior of the tubular duct 18. The upper end of the tubular duct 18 has a vent 27 to allow equilibration with ambient air pressure and prevent back siphoning.

The delivery of mains water M from the mains water inflow pipe 17 is dictated by a ball cock valve assembly that locates entirely within the tubular duct 18. The float 19 of the ball cock valve assembly is dimensioned, with its circumferential flange, to substantially fill a major proportion of the internal diameter of the tubular duct 18 and the lever arm 20 that operates the ball cock valve 21 is linked to the float 19 by a long connecting rod 22 with a dog let to enable centralisation of the float 19 in the duct 18 and reduce risk of the float 19 tilting and jamming in the duct 18. The float 19 is rigidly attached to the connecting rod 22 and the connecting rod 22 is pivotted to the lever 20 by pivot pin 29.

The buoyancy of the float 19 is determined so that it will sink with the falling water level to pull open the ball cock valve 21 when the water level falls below an acceptable minimum level. This minimum level is relatively low to allow for minimal

mains top up should grey water supply soon be available. It may, for example, be set at the volumetric equivalent of one to two water closet flushes.

The module comprising the ball cock valve 21 itself is suitably stabilised against tortional forces during assembly and operation by one or more detent pins 23 formed on the interior of the tubular duct 18 adjacent the mounting point of the ball cock valve 21 module on the tubular duct 18.

As explained earlier above, the provision of the tubular duct 18 constraining the inflow of mains water past the ball cock float 19 reduces foaming in the tank 2. The tubular duct 18 itself enables the mains inflow to be provided safely without risk of contamination of the mains water supply. The duct 18, furthermore, constrains and guides the ball cock valve assembly reducing stresses and strains and thereby minimising need for maintenance of the assembly.

CLAIMS

1. A grey water processing system which comprises a filtration unit to filter out particulate contaminants and a storage tank to store the grey water processed by the filtration unit, wherein the storage tank has an inflow for water from the mains water system, the inflow being regulated by a regulating valve with associated water level dependent switching means , the inflow opening into a tube that encompasses the inflow and valve and directs the mains water therefrom downwardly through the tube, the tube opening into the tank toward the bottom of the tank and being provided with an air vent to prevent siphoning back up the tube.

2. A grey water processing system as claimed in claim 1 wherein the regulating valve is a ball cock valve.

3. A grey water processing system which comprises a filtration unit to filter out particulate matter and a storage tank to store the grey water processed by the filtration unit, wherein the filtration unit comprises a tank with a grey water inflow at the bottom of the tank, a filter positioned thereabove with a pumping means to pump it toward the storage tank whereby particulate matter filtered from the grey water by the filter is partitioned into the lower part of the tank to gravitate toward the floor of the tank away from the filter and pump.

4. A grey water processing system as claimed in claim 3, wherein the inflow for the grey water has coupled thereto a chamber with air vents to aspirate air and adapted to accommodate processing chemicals whereby the chemicals may be drawn into the in flowing grey water.

5. A grey water processing system is claimed in claim 4, wherein the filtration unit tank is a substantially cylindrical tank and the inflow of grey water opens into the base of the tank substantially tangentially to the cylindrical inner wall of the tank to

cause the in flowing grey water to flow around the tank in a swirling motion to cause suspended solids to separate and migrate to the wall of the tank.

6. A grey water processing system as claimed in claim 4 or 5, wherein the storage tank is provided with switch means responsive to the level of water in the tank to switch off the pump means should the level of water in the storage tank rise above a predetermined maximum level.

7. A grey water processing system as claimed in claim 6 wherein the storage tank further has a switch means responsive to the level of water in the tank to switch on the pump means should the water level in the storage tank fall below a predetermined lower or minimum level.

8. A grey water processing system as claimed in claim 6 or 7 wherein the switch means comprises a float switch.

9. A storage tank for a grey water processing system wherein the storage tank has an inflow for water from the mains water system, the inflow being regulated by a regulating valve with associated water level dependent switching means , the inflow opening into a tube that encompasses the inflow and valve and directs the mains water therefrom downwardly through the tube, the tube opening into the tank toward the bottom of the tank and being provided with an air vent to prevent siphoning back up the tube.

10. A filtration unit for a grey water processing system wherein the filtration unit comprises a tank with a grey water inflow at the bottom of the tank, a filter positioned thereabove with a pumping means to pump it toward a separate storage tank whereby particulate matter filtered from the grey water by the filter is partitioned into the lower part of the filtration unit tank to gravitate to the floor of the tank away from the filter and pump.

11. A grey water processing system as claimed in claim 1 and any of claims 2 to 8.

Amendments to the claims have been filed as follows

1. A grey water processing system which comprises a filtration unit to filter out particulate contaminants and a storage tank to store the grey water processed by the filtration unit, wherein the storage tank has an inflow for water from the mains water system, the inflow being regulated by a regulating valve with associated water level dependent switching means, the inflow opening into a tube that encompasses the inflow and valve and directs the mains water therefrom downwardly through the tube, the tube opening into the tank toward the bottom of the tank and being provided with an air vent to prevent siphoning back up the tube.

2. A grey water processing system as claimed in claim 1 wherein the regulating valve is a ball cock valve.

3. A grey water processing system as claimed in claim 1 or claim 2, wherein the filtration unit comprises a tank with a grey water inflow at the bottom of the tank, a filter positioned thereabove with a pumping means to pump the grey water toward the storage tank such that, in use, particulate matter filtered from the grey water by the filter is partitioned into the lower part of the tank to gravitate toward the floor of the tank away from the filter and pump.

4. A grey water processing system as claimed in claim 3, wherein the inflow for the grey water has coupled thereto a chamber with air vents to aspirate air and adapted to accommodate processing chemicals such that, in use, the chemicals may be drawn into the in flowing grey water.

5. A grey water processing system is claimed in claim 4, wherein the filtration unit tank is a substantially cylindrical tank and the inflow of grey water opens into the base of the tank substantially tangentially to the cylindrical inner wall of the tank to cause the in flowing grey water to flow around the tank in a swirling motion to cause suspended solids to separate and migrate to the wall of the tank.

6. A grey water processing system as claimed in claim 4 or 5, wherein the storage tank is provided with switch means responsive to the level of water in the tank to switch off the pump means should the level of water in the storage tank rise above a predetermined maximum level.

7. A grey water processing system as claimed in claim 6 wherein the storage tank further has a switch means responsive to the level of water in the tank to switch on the pump means should the water level in the storage tank fall below a predetermined lower or minimum level.

8. A grey water processing system as claimed in claim 6 or 7 wherein the switch means comprises a float switch.

9. A storage tank for a grey water processing system wherein the storage tank has an inflow for water from the mains water system, the inflow being regulated by a regulating valve with associated water level dependent switching means, the inflow opening into a tube that encompasses the inflow and valve and directs the mains water therefrom downwardly through the tube, the tube opening into the tank toward the bottom of the tank and being provided with an air vent to prevent siphoning back up the tube.

10. A storage tank substantially as hereinbefore described with reference to the accompanying drawings.

11. A grey water processing system substantially as hereinbefore described with reference to the accompanying drawings.

INVESTOR IN PEOPLE

Application No: GB 0018288.1
Claims searched: 1,2 and 9

Examiner: D. Haworth
Date of search: 17 January 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): E1X (XK7B); E1T (T7C2)

Int Cl (Ed.7): E03B 11/02

Other: Online: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	None	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Application No: GB 0018288.1
Claims searched: 3-8 and 10

Examiner: D. Haworth
Date of search: 24 August 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): E1X (XK7D); B1D (DNRS)

Int Cl (Ed.7): E03B 7/07; B01D 35/02, 36/04

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2269417 A (Barlow) - see Fig.3	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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EUR-CL (EPC): E03B001/04 , B01D035/027

US-CL-CURRENT: 54/80.1 , 102/412